

CLAIMS

5 We Claim:

1. A multi-layer cable having a unsaturated outer layer, usable as a reinforcing element for a tire crown reinforcement, comprising a core (C0) of diameter d_0 surrounded by an intermediate layer (C1) of six or seven wires ($N = 6$ or 7) of diameter d_1 wound together in a helix at a pitch p_1 , this layer C1 itself being surrounded by an outer layer (C2) of P wires of diameter d_2 wound together in a helix at a pitch p_2 , P being less by 1 to 3 than the maximum number P_{\max} of wires which can be wound in one layer about the layer C1, this cable being characterised in that it has the following characteristics (d_0 , d_1 , d_2 , p_1 and p_2 in mm):

- 15 - (i) $0.28 \leq d_0 < 0.50$;
 - (ii) $0.25 \leq d_1 < 0.40$;
 - (iii) $0.25 \leq d_2 < 0.40$;
 - (iv) for $N = 6$: $1.10 < (d_0 / d_1) < 1.40$;
 for $N = 7$: $1.40 < (d_0 / d_1) < 1.70$;
20 - (v) $5.3 \pi (d_0 + d_1) < p_1 < p_2 < 4.7 \pi (d_0 + 2d_1 + d_2)$; and
 - (vi) the wires of layers C1 and C2 are wound in the same direction of twist.

2. The cable according to Claim 1, of construction $[1+N+P]$, wherein the core of which is formed by a single wire.

25 3. The cable according to Claim 2, selected from the group consisting of the constructions $[1+6+10]$, $[1+6+11]$, $[1+6+12]$, $[1+7+11]$, $[1+7+12]$ and $[1+7+13]$.

4. The cable according to Claim 1, of construction $[1+6+P]$.

30 5. The cable according to Claim 4, of construction $[1+6+11]$.

6. The cable according to Claim 1, which satisfies the following relationships:

- 35 - $0.25 \leq d_1 \leq 0.35$;
 - $0.25 \leq d_2 \leq 0.35$.

7. The cable according to Claim 1, which satisfies the following relationship:

40 $0.25 \leq d_0 \leq 0.30$.

8. The cable according Claim 1, characterised in that it is a steel cable.

9. The cable according to Claim 8, characterised in that the steel is a carbon steel.

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10. The cable according to Claim 1, which satisfies the relationship:

$$5.5 \pi (d_0 + d_1) < p_1 < p_2 < 4.5 \pi (d_0 + 2d_1 + d_2).$$

5 11. The cable according to Claim 1, wherein said core comprises M wires, wherein M is equal to or greater than 2.

12. A tire having a crown reinforcement which comprises a multi-layer cable having a unsaturated outer layer, comprising a core (C0) of diameter d_0 surrounded by an intermediate
10 layer (C1) of six or seven wires ($N = 6$ or 7) of diameter d_1 wound together in a helix at a pitch p_1 , this layer C1 itself being surrounded by an outer layer (C2) of P wires of diameter d_2 wound together in a helix at a pitch p_2 , P being less by 1 to 3 than the maximum number P_{max} of wires which can be wound in one layer about the layer C1, this cable having the following characteristics (d_0 , d_1 , d_2 , p_1 and p_2 in mm):

- 15
- (i) $0.28 \leq d_0 < 0.50$;
 - (ii) $0.25 \leq d_1 < 0.40$;
 - (iii) $0.25 \leq d_2 < 0.40$;
 - (iv) for $N = 6$: $1.10 < (d_0 / d_1) < 1.40$;
 - 20 for $N = 7$: $1.40 < (d_0 / d_1) < 1.70$;
 - (v) $5.3 \pi (d_0 + d_1) < p_1 < p_2 < 4.7 \pi (d_0 + 2d_1 + d_2)$; and
 - (vi) the wires of layers C1 and C2 are wound in the same direction of twist.

13. The tire according to Claim 12, wherein the multi-layer cable, of construction $[1+N+P]$,
25 has a core formed by a single wire.

14. The tire according to Claim 13, wherein the multi-layer cable is selected from among the group consisting of cables of the constructions $[1+6+10]$, $[1+6+11]$, $[1+6+12]$, $[1+7+11]$,
30 $[1+7+12]$ and $[1+7+13]$.

15. The tire according to Claim 13, wherein the multi-layer cable has a construction $[1+6+P]$.

16. The tire according to Claim 15, wherein the multi-layer cable has a construction
35 $[1+6+11]$.

17. The tire according to Claim 12, wherein the following relationships are satisfied :

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- $0.25 \leq d_1 \leq 0.35$;
 - $0.25 \leq d_2 \leq 0.35$.

18. The tire according to Claim 12, wherein the following relationship is satisfied :

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$$0.25 \leq d_0 \leq 0.30.$$

19. The tire according Claim 12, wherein the multi-layer cable is a steel cable.

20. The tire according to Claim 19, wherein the steel is a carbon steel.

21. The tire according to Claim 12, wherein the following relationship is satisfied :

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$$5.5 \pi (d_0 + d_1) < p_1 < p_2 < 4.5 \pi (d_0 + 2d_1 + d_2).$$

22. A composite fabric usable as a crown reinforcement ply for a tire, comprising a matrix of rubber composition reinforced by a multi-layer cable having a unsaturated outer layer, comprising a core (C0) of diameter d_0 surrounded by an intermediate layer (C1) of six or seven wires ($N = 6$ or 7) of diameter d_1 wound together in a helix at a pitch p_1 , this layer C1 itself being surrounded by an outer layer (C2) of P wires of diameter d_2 wound together in a helix at a pitch p_2 , P being less by 1 to 3 than the maximum number P_{\max} of wires which can be wound in one layer about the layer C1, this cable having the following characteristics (d_0 , d_1 , d_2 , p_1 and p_2 in mm):

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- (i) $0.28 \leq d_0 < 0.50$;
- (ii) $0.25 \leq d_1 < 0.40$;
- (iii) $0.25 \leq d_2 < 0.40$;
- 20 - (iv) for $N = 6$: $1.10 < (d_0 / d_1) < 1.40$;
for $N = 7$: $1.40 < (d_0 / d_1) < 1.70$;
- (v) $5.3 \pi (d_0 + d_1) < p_1 < p_2 < 4.7 \pi (d_0 + 2d_1 + d_2)$; and
- (vi) the wires of layers C1 and C2 are wound in the same direction of twist.

23. The fabric according to Claim 22, wherein the multi-layer cable, of construction $[1+N+P]$, has a core formed by a single wire.

24. The fabric according to Claim 23, wherein the multi-layer cable has a construction $[1+6+P]$.

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25. The fabric according to Claim 24, wherein the multi-layer cable has a construction $[1+6+11]$.

26. The fabric according to Claim 22, wherein the multi-layer cable is selected from among the group consisting of cables of the constructions $[1+6+10]$, $[1+6+11]$, $[1+6+12]$, $[1+7+11]$, $[1+7+12]$ and $[1+7+13]$.

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27. The fabric according to Claim 22, wherein the following relationships are satisfied :

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- $0.25 \leq d_1 \leq 0.35$;
- $0.25 \leq d_2 \leq 0.35$.

28. The fabric according to Claim 27, wherein the following relationship is satisfied :

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$$0.25 \leq d_0 \leq 0.30.$$

29. The fabric according Claim 22, wherein the multi-layer cable is a steel cable.
30. The fabric according to Claim 29, wherein the steel is a carbon steel.
- 5 31. The fabric according to Claim 22, wherein the following relationship is satisfied :
- $$5.5 \pi (d_0 + d_1) < p_1 < p_2 < 4.5 \pi (d_0 + 2d_1 + d_2).$$
32. The fabric according to Claim 22, wherein the cable density is between 20 and 70 cables
10 per dm of fabric.
33. The fabric according to Claim 32, wherein the cable density is between 30 and 60 cables
per dm of fabric.
- 15 34. The fabric according to Claim 22, wherein the width ℓ of the bridge of rubber
composition, between two adjacent cables, is between 0.5 and 2.0 mm.
35. The fabric according to Claim 34, wherein the width ℓ is between 0.8 and 1.6 mm.
- 20 36. The fabric according to Claim 22, wherein the rubber composition has, in the vulcanised
state, a secant tensile modulus MA10 which is greater than 5 MPa.
37. The fabric according to Claim 36, wherein the rubber composition has, in the vulcanised
state, a modulus MA10 which is between 5 and 20 MPa.
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